

Strategies to facilitate exposure to internet-delivered health behavior change interventions aimed at adolescents or young adults: a systematic review.

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Abstract

The Internet is considered to be a promising delivery channel of interventions aimed at promoting healthful behaviors, especially for adolescents and young adults. Exposure to these interventions, however, is generally low. A more extensive exploration of methods, strategies, and their effectiveness with regard to facilitating exposure is therefore timely, because this knowledge is crucial to improve the use of such interventions and, subsequently, to increase behavioral change. Therefore, a systematic review of the literature was conducted, resulting in 838 studies based on title selection, of which 26 studies met the eligibility criteria. The systematic review resulted in an overview of methods and strategies that have been used to facilitate exposure. Patterns of effective strategies could be observed, such as the combination of tailored communication and the use of reminders and incentives. Nevertheless, exposure-specific theories need to be developed and objective exposure measures should be tracked and reported in future studies.

Keywords

Internet-delivered interventions, exposure, adolescents, young adults

Introduction

The Internet holds the promise of reaching large numbers of people and is very suitable to deliver interventions aimed at primary prevention of physical chronic diseases through health behavior change (Bernhardt & Hubley, 2001). Internet-delivered interventions may be particularly suitable to reach the current generation of adolescents and young adults, because this generation grew up with the Internet (Roberts & Foehr, 2008) and are probably more open toward new possibilities offered by this medium than today's adults are (Leung, 2003). Although this age group might be interested in feedback on lifestyle behaviors (De Nooijer, Veling, Ton, De Vries, & De Vries, 2008), they are, in contrast to older people who are more often confronted with chronic diseases, not likely to be internally motivated to invest time in health behavior change interventions (De Nooijer et al., 2005). This age group is, however, an important target group for health promotion, because many health risk behaviors are acquired during this period in life and may track to a certain extent into adulthood, thereby affecting not only current health but also health in later life (Kelder, Perry, Klepp, & Lytle, 1994; Te Velde, Twisk, & Brug, 2007). Hence, the focus of this

study will be on Internet-delivered interventions aimed at adolescents or young adults.

A meta-analysis (Portnoy, Scott-Sheldon, Johnson, & Carey, 2008) and systematic reviews (Myung, McDonnell, Kazinets, Seo, & Moskowitz, 2009; Neville, O'Hara, & Milat, 2009; Vandelandotte, Spathonis, Eakin, & Owen, 2007) indicate that Internet-delivered interventions can be effective in changing behavior, even in comparison with face-to-face interventions (Steele, Mummery, & Dwyer, 2009). Evidence from efficacy trials, however, indicates that exposure to these interventions is low, especially when they are implemented in real life (Bennett & Glasgow, 2009; K. E. Evers, Cummins, Prochaska, & Prochaska, 2005).

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Participants tend to spend only a limited amount of time at an intervention (Eysenbach, 2005). True exposure, that is, accessing the intervention website and actually using it, is necessary for an intervention to induce behavior changes. For Internet-delivered interventions, exposure consists of accessing the intervention website (i.e., a first visit), staying on the intervention website to actually use it, and revisiting the intervention website. The latter only applies to interventions that are developed to be visited multiple times. A systematic review of the literature was conducted to gain insight into the use and the effectiveness of methods and strategies aimed at facilitating exposure to Internet-delivered interventions. A more extensive exploration is timely, because this knowledge is crucial to improve the use of such interventions and, consequently, to increase behavioral change. Therefore, the following research questions (RQs) were formulated:

- RQ 1:* Which methods and strategies are used to facilitate exposure to existing Internet-delivered interventions?
- RQ 2:* On which theories or empirical data are these methods and strategies based?
- RQ 3:* Which measures are used to assess exposure and how are these exposure measures linked to strategies to facilitate exposure?
- RQ 4:* What are the potential effects of strategies to facilitate exposure and how are these related to their theoretical or empirical foundation?

Whereas a method is a theory-based technique, a strategy is a way of organizing, operationalizing, and delivering the method (Bartholomew, Parcel, Kok, & Gottlieb, 2006). For example, sending e-mail messages to encourage participants to visit the intervention and set goals for reducing and eliminating cigarette use (An et al., 2006) would be a practical strategy based on the theory-based technique of goal setting. The concepts of methods and strategies are defined as such within the Intervention Mapping approach. This approach is used to design theory- and evidence-based health promotion programs and stresses the importance of having a theoretical and empirical foundation for decisions regarding the choice of methods and strategies (Bartholomew et al., 2006).

Method

A systematic review was conducted, according to the Cochrane guidelines (Higgins & Green, 2006), to answer the research questions.

Search Strategy

We searched (February 18, 2008) the PubMed, PsycINFO, and Web of Science databases using the following query: (Internet* OR web* OR online*) AND (prevention OR

intervention OR "health promotion" OR "health education" OR "health communication" OR (behav* AND change)). The search was limited to the time period January 1, 1995–January 1, 2008, and to literature in English. We deliberately used a very broad search strategy to include firstly as much literature as possible and to reduce the possibility of omissions.

Selection Criteria

A study was eligible for inclusion when describing the evaluation (in an original article published in a peer-reviewed journal) of an Internet-delivered intervention aimed at the primary prevention of physical chronic diseases through behavior change, targeted at adolescents or young adults (aged 12-25). The intervention should consist of a website offered in a noncontrolled setting *or* a controlled setting (e.g., class period) with freedom to navigate. The latter restriction was added because an intervention consisting of a website without freedom to navigate (i.e., linear) offered in a controlled setting would lead participants to use the intervention website as desired, but would make it impossible to study the effectiveness of methods and strategies used to facilitate exposure. The intervention should be targeted at end users (not intermediaries), aged 12-25, from the general public (not patients or institutionalized participants). The study being reported in accordance with the CONSORT Statement (Moher, Schulz, & Altman, 2001) was not a selection criterion, because our focus was on exposure to the intervention instead of the intervention's effectiveness regarding behavior change.

Review Procedure

The review procedure comprised three phases to identify relevant studies and was performed independently by two reviewers using the selection criteria described above. During the first phase, studies were reviewed based on title only. We used the most conservative approach, meaning that if in doubt, studies were included for the second phase during which they were reviewed based on their abstract. If still in doubt, we included the study for the third phase during which the full article was reviewed. After this phase, both reviewers (RC and JdN) discussed whether studies met the inclusion criteria until agreement was reached. To identify more eligible studies, the same procedure was repeated for articles in reference lists of included studies.

Data Abstraction

A standardized extraction form was used to summarize intervention and sample characteristics, methods and strategies that could facilitate exposure, theories or empirical data on which they were based, and exposure measures. Two reviewers (RC and JdN) independently gathered the relevant

information and discussed this afterwards to improve the reliability of their data abstraction. Methods and strategies were labeled for the sake of clarity, and both reviewers fully agreed on this labeling. This systematic review was explorative in nature and we decided on labeling after data abstraction and based this labeling on the methods and strategies used in interventions that were included in the final sample. The reason for this decision was that we did not want to exclude any methods or strategies a priori and to guarantee openness regarding methods and strategies that are used in practice. The categorization of health communication by Hawkins, Kreuter, Resnicow, Fishbein, and Dijkstra (2008) was used to separate targeted communication from tailored communication. Corresponding authors of included studies were contacted by e-mail (April, 2008) to complete the extraction forms (if the information provided in the article was insufficient). Initially, the authors had 3 weeks to respond, but we sent a reminder by e-mail after 3 weeks to increase the response rate (May, 2008).

Results

More than 12,000 titles were initially identified because of the broad search strategy. A total of 838 studies were selected on the basis of their title, of which 26 studies met the eligibility criteria. There was full agreement between the two reviewers, although it is possible that there were multiple and different reasons why a study could be excluded. Of the 119 studies that were included based on their abstract but excluded based on the full article, the primary reasons for rejection were as follows: no evaluation study (10.1%, $n = 12$); the study was not published as an original article in a peer-reviewed journal (2.5%, $n = 3$); the study did not describe an intervention aimed at primary prevention of physical chronic diseases through behavior change (11.8%, $n = 14$); the intervention was not targeted at adolescents or young adults (aged 12-25) (58.0%, $n = 69$); the intervention did not (at least partly) consist of a website (10.1%, $n = 12$); the intervention was not offered in a noncontrolled setting or a controlled setting with freedom to navigate (7.6%, $n = 9$). Figure 1 gives an overview of the different phases of the review procedure. These 26 studies described 22 interventions that were related to smoking cessation (8), sexual behavior (4), alcohol use (4), physical activity (2), nutrition (1), physical activity and nutrition (1), health and lifestyles in general (1), and weight loss (1) (Table 1).

All corresponding authors ($n = 21$) were contacted, of whom 14 (67%) responded to our request to complete the extraction forms. Tables 1 and 2 summarize all data abstracted from the articles and information provided by the corresponding authors and were used to answer our research questions. Five interventions were excluded from these tables (Chen, Yeh, & Chao, 2006; Chiauzzi, Green, Lord, Thum, & Goldstein, 2005; W. Evers & Carol, 2007; Obermayer, Riley, Asif, & Jean-Mary, 2004; Walters, Vader, & Harris, 2007), because

exposure measures were unavailable, resulting in data from 17 interventions for the present review.

RQ1: Which Methods and Strategies Are Used to Facilitate Exposure to Existing Internet-Delivered Interventions? (Table 1)

Nine interventions customized their information to a certain extent. According to the categorization of health communication by Hawkins et al. (2008), five interventions used targeted communication (defined as group targeted, e.g., appealing for African American teenage girls) and six interventions used tailored communication (defined as individually tailored, e.g., personal feedback). Three of those six interventions combined tailored communication with monitoring of health behavior (change).

Nine interventions offered facilities to support their participants, either through professionals (e.g., ask-the-expert; six interventions) or peers (six interventions). Peer support was enabled through sharing of information (e.g., personal experiences with behavior change) or direct communication with other peers. Four interventions offered a discussion board or forum to facilitate opportunities to support.

Several strategies have been used with regard to the delivery of the intervention's content. Five interventions provided content in an interactive way. Content was made easily accessible (e.g., through a simple linear design instead of a more open design with freedom to choose) by four interventions. Conditional progress, meaning that participants can only access certain modules or parts of a website once the previous are finished or during a certain time period, was used by two interventions.

Other strategies were to embed the Internet-delivered intervention in a social context (e.g., link it to school assignments; three interventions), the use of reminders to visit or revisit or invitations to participate (either physical or through e-mail; seven interventions), and the use of incentives (six interventions).

RQ2: On Which Theories or Empirical Data Are These Methods and Strategies Based? (Table 2)

As shown in the second column of Table 2, social learning (cognitive) theory (Patten et al., 2006; Patten et al., 2007; Suminski & Petosa, 2006), the transtheoretical model (Escoffery, McCormick, & Bateman, 2004), the information-motivation-behavioral skills model (Barak & Fisher, 2003), self-regulation theory, and the theoretical fields of social support (Escoffery et al., 2004; Marks et al., 2006) and social norms (Saitz et al., 2007; Thombs et al., 2007) were described as the basis for methods and strategies. Although the aim of these theories is to explain behavior or the process of behavior change, the methods and strategies that are derived from

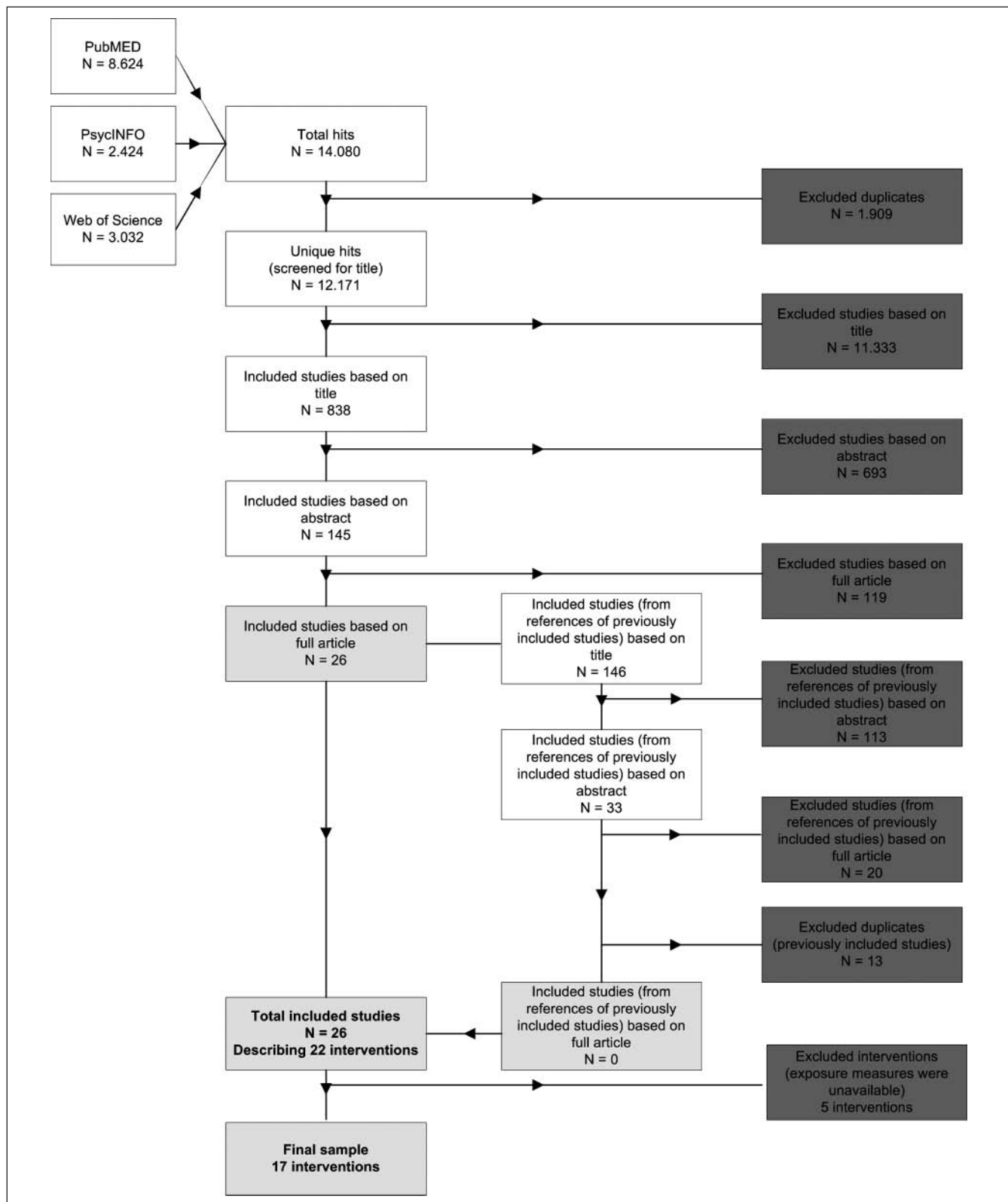


Figure 1. Flow-chart review procedure

Table 1. Overview of Interventions and the Employed Methods, Strategies, and Measurement of Exposure

Study	Topic	Country	N	Participants ^a		Customization		Support		Delivery of content				Measurement method	Per component/ website as a whole			
				Age (years)	Female (%)	Targeted comm.	Tailored comm.	Monitoring	By professional peers	By Discussion board	Interactive content	Accessible content	Conditional progress			Variable content	Social context	Invitations/ reminders
An et al. (2006)	SC	USA	257	M = 20.1 (SD = 1.6)	70.4	x	x	x	x	x					x	x	O	W
Barak & Fisher (2003)	SB	Canada	NA	NA	NA						x		x				O	C
Chen & Yeh (2006)	SC	Taiwan	39	M = 17 (SD = 0.68)	NA				x	x							O	C
Escoffery, McCormick, & Bateman (2004)	SC	USA	35	M = 21	57.1		x		x	x		x			x		O/S	C
Gilbert et al. (2005)	SB	USA	1,242	13: 11.7%; 14: 16.9%; 15: 24.4%; 16: 25.2%; 17: 21.8%	73.8												O	W
Long et al. (2006)	N	USA	21	M = 13	42.9		x										A	W
Lou, Zhao, Gao, & Shah (2006)	SB	China	624	≤15: 20.7%; 16: 16; 22.9%; 17: 2.6%; 18: 20.2%; ≥19: 33.6%	39.7				x	x					x		O	C
Marks et al. (2006)	PA	USA	181	M = 12.2 (SD = 1.0)	100						x						S	W
Mermelstein & Turner (2006)	SC	USA	181	M = 16.3 (1.04)	55.2				x							x	O/S	W
Michaud & Colom (2003)	HL	Switzerland	NA	NA	63				x								O	W
Patten et al. (2006, 2007)	SC	USA	70	M = 15.7 (SD = 1.3)	50		x		x	x		x					O	C
Roberto, Zimmerman, Carlyle, & Abner (2007)	SB	USA	139	M = 15.5 (SD = 0.6)	58.3								x		x	x	O	C
Satz et al. (2007)	AU	USA	650	M = 18.14 (SD = 0.42)	63.7			x								x	O	C
Suminski & Petosa (2006)	PA	USA	127	M = 21.3 (SD = 5.5)	65.4			x	x							x	O	W
Thombs et al. (2007)	AU	USA	192	~18-19	~67			x				x				x	O	C
White et al. (2004); Williamson et al. (2005, 2006)	WL	USA	57	M = 13.19 (SD = 1.37)	100		x		x					x			O	C
Woodruff et al. (2008, 2007)	SC	USA	77	M = 16.5; range: 14-19	49		x		x	x						x	A	W

Note: SC = smoking cessation; SB = sexual behavior; N = nutrition; PA = physical activity; HL = health and lifestyles; AU = alcohol use; WL = weight loss; O = objectively tracked; S = self-report; A = attendance; C = measurement per component; W = measurement of intervention's website as a whole; NA = not available.
a. Refers only to participants assigned to an intervention or condition that involved use of a website.

Table 2. Description of Methods, Strategies, Foundation and Their Effectiveness Regarding Exposure to Internet-Delivered Interventions

Study/setting	Methods, strategies, and foundation	Exposure measures
An et al. (2006); 20 weeks during which participants should visit every week	Maintaining engagement with our audience on several fronts [Me] that would eventually link back to antismoking messages [St]. (<i>targeted communication</i>) Linear structure, with step-by-step guidance through specific weekly tasks [St]. The benefits of a simple linear design may be particularly pronounced when a participant's investment in a website is low [T]. (<i>accessible content</i>) Peer coaches who provided weekly proactive personal e-mail support [St] to encourage participants to set goals for reducing or eliminating cigarette use [Me]. (<i>peer support</i>) The interactive quiz in which tailored messages are presented [St]. (<i>interactive content; tailored communication</i>) Peer coaches provided follow-up e-mail messages to individuals who had not yet completed weekly tasks [St]. (<i>invitations/reminders</i>) US\$10 gifts for each week of participation [St]. (<i>incentives</i>) Expert and up-to-date content, in text and graphic form, and with as much interactivity as possible [St]. (<i>interactive content</i>) Guided by the information-motivation-behavioral skills (IMB) model [T], information was script like in nature and could easily be deployed [St]. (<i>accessible content</i>)	Participation (= return to website and complete weekly tracker and interactive quiz): $M = 95\%$; range: 89%-98%; no decline over 20 weeks No difference between weekly interactive quizzes that addressed smoking compared with general interest quizzes ($p = .90$)
Barak & Fisher (2003); ~8 months		Frequency: unique visitors: 75,869/79,888 (English/French) visited more than once: 9,821/11,187 Duration: time per visit: $M = 11:53/10:23$ min home: $M = 0:36/0:34$ min quiz: $M = 0:06/0:30$ min Frequency: use: $M = 14.7$; range: 0-197 discussion posted: $M = 3.6$; range: 0-33
Chen & Yeh (2006); 6-week intervention	A discussion forum was set up to share thoughts and feelings during the cessation process and for peer-to-peer support [St] to strengthen their willingness to quit smoking [T]. (<i>peer support; discussion board</i>)	Frequency (use): (self-report) 94% all sessions text: 94.1% quizzes: 88.2% quitting resources: 64.7% personal stories: 23.5% ask-the-expert: 5.9% discussion boards: 23.5% Q&A: 29.4% top ten reasons contest: 35.3% (tracking system) 60% all sessions → 82.4% agreement with self-report
Escoffery, McCormick, & Bateman (2004); four sessions; each available for 2 weeks	Four sessions applying the transtheoretical model and the theory of social support [T]. Tailored messages based on staging question at each intervention session [St]. (<i>tailored communication</i>) Social support components: opportunities to ask-the-expert questions by e-mailing questions; share stories through a personal story area; talk to other participants through stage-matched discussion boards [St]. (<i>professional support; peer support; discussion board</i>) Applying principles of web usability [St]. (<i>accessible content</i>) Participants received US\$5 for each session [St]. (<i>incentives</i>)	Frequency: unique visitors: 75,869/79,888 (English/French) visited more than once: 9,821/11,187 Duration: time per visit: $M = 11:53/10:23$ min home: $M = 0:36/0:34$ min quiz: $M = 0:06/0:30$ min Frequency: use: $M = 14.7$; range: 0-197 discussion posted: $M = 3.6$; range: 0-33
Gilbert et al. (2005); ~3 months	NA	Frequency: unique visitors: 53,564 Duration (attendance): $M = 5$ hr
Long et al. (2006); 3 weeks	Website tailored to the social and developmental preferences of adolescents and designed to be age relevant, fun, and participatory [St]—capturing adolescent attention while allowing individual control over the pace of learning [T]. (<i>targeted communication</i>) Intervention was delivered in the school's computer classroom 45 min before school began over a 3-week period [St]. (<i>social context</i>) Incentives were provided to attend the sessions. One larger “grand prize” was given at the end of the 3-week period [St]. (<i>incentives</i>)	Frequency: unique visitors: 53,564 Duration (attendance): $M = 5$ hr

(continued)

Table 2. (continued)

Study/setting	Methods, strategies, and foundation	Exposure measures
Lou, Zhao, Gao, & Shah (2006); 10 months during which the website was updated every 2 weeks	Activities: (1) provision of sex and reproductive health knowledge and services information by web pages; (2) ten 10-min educational videos were posted; (3) professional counseling by e-mail; (4) discussion on the bulletin board system [St]. At baseline, expert e-mail was cited by 54% as preferable and online discussion by 30% [E]. (<i>professional support; discussion board</i>) Information of the website was provided by writing letters to students and their parents, informing teachers of intervention schools/universities, and disseminating a small card (like a name card) with the information of the website to each student [St]. (<i>invitations/reminders</i>)	Frequency: 15,357 visits/10 months Per month (visits): 0: 6.3%; <1: 26.9%; 1-4: 61.1%; ≥5: 5.7% Per activity: e-mail counseling: used 11 times discussion on the bulletin board system: 452 participants registered; only a few posted comments Duration (in minutes per visit): <10: 16.3%; 10-20: 43.8%; ≥20: 39.9% Frequency (views; self-report): 1-3: 45%; 4-6: 25%; 7-10: 13%; >10: 16% Duration (in total; self-report): M = 89 (SD = 64.8) min Frequency: visiting: 56.9% (self-report) number of pages: M = 14.5 (SD = 12.8) Duration: M = 33.0 (SD = 32.3) min total viewing time
Marks et al. (2006); 2-week period in which participants should review the materials at least four times	Website included interactive games, a quiz, downloadable charts to plan daily activities, and interactive demonstrations of different types of activities [St]. These addressed barriers and benefits of physical activity, goal setting, and social support [T]. (<i>interactive content</i>)	
Mermelstein & Turner (2006); website available throughout the whole intervention	Website contained facts about smoking and health; motivational messages from teens who had quit; strategies and tips for not smoking; and access to incentive gear [St]. (<i>peer support; incentives</i>)	
Michaud & Colom (2003); 4 months	Participants can ask personal questions using a pseudonym, which ensures complete anonymity [St]. (<i>professional support</i>)	Frequency (during year 2001): 181,557 visits and 4,382 questions Frequency: days of use: M = 6.8 (SD = 7.1) logins: M = 10.9 (SD = 15.3); 52% during the first 3 weeks
Patten et al. (2006, 2007); 24 weeks, home based	Web architecture and design consistent with the National Cancer Institute web usability guidelines [St]. (<i>accessible content</i>) Social learning (cognitive) theory, health communication and decision-making theories formed the conceptual basis for the intervention [T]. A private e-mail service allowed participants to ask questions of an expert and receive confidential responses within 24 hr [St]. A discussion support group consisted of an e-mail service, which posted messages and responses to and from participants [St]. (<i>peer support; professional support; discussion board</i>) Videos of personal stories; first-person accounts of teens who had quit or were trying to quit, representing various ethnic and gender backgrounds [St]. These stories addressed barriers to quitting and how the barriers were managed [T]. (<i>targeted communication</i>)	Page views: 6,825 interactive pages (Mdn = 65, range: 0-848); 883 informational pages (Mdn = 6, range: 0-86). % total page views per component: discussion support group: 35% quit plan: 30% quit notes: 10% my journal: 4% ask-an-expert, myth quizzes, real-time chat: 3% personal stories, art gallery, video: 2% Percentage of participants decreased over 24 weeks ($p < .001$); 7% never used; 86% used at least once after 3 weeks 212 postings to discussion support group; 28 postings to ask an expert

(continued)

Table 2. (continued)

Study/setting	Methods, strategies, and foundation	Exposure measures
Roberto, Zimmerman, Carlyle, & Abner (2007); 7 weeks: one activity (± 15 min) per week and a 7th "make-up week" in which all six activities were accessible	Participants who completed a weekly activity were given an opportunity to enter a drawing for a gift card to a national retail store [St]. Teachers played a vital role in reminding students about the intervention and encouraging students to participate [St]. Each activity was put online for one week and all six activities were put online during week seven to encourage and enhance participation [St]. (<i>incentives; invitations/reminders; social context; conditional progress</i>) To make the experience more interesting and realistic, images were randomly selected at various points so they would be different each time [St]. (<i>variable content</i>)	Frequency (use per activity): sensation-seeking scale: 60.4% truth or myth: 62.6% impulsive decision-making scale: 46.0% risky behavior: 52.5% choose your own adventure/refusal skill activity: 41.0% radio public service announcement contest: 18.0% 88.5% used at least one activity No difference in completion rate by invitation group: 54.8% alcohol specific vs. 54.6% general health. Follow up: 85.1% alcohol specific vs. general health 85.7%
Saitz et al. (2007); one-time use plus 1 month follow-up	Minimal intervention: three screens; comparison to local norms, information about alcohol [St]. Extensive intervention: three additional screens; highest blood alcohol concentration level in past month, effects of alcohol on cognition and behavior, drinking consequences with normative information, amount of money spent per week and year, number of calories consumed per month and amount of time required on a treadmill to burn them [St]. (<i>tailored communication; monitoring</i>) Intervention was based on elements of BASICS, motivational interviewing, self-change approaches, and feedback about social norms [T]. E-mail invitation to a general health or alcohol-specific screening [St]. Two e-mail reminders were sent to nonrespondents [St]. (<i>invitations/reminders</i>) Web assignments [St] provided participants the opportunity to apply SCT strategies [T]; participants were required to continually examine their previously completed web assignments [St]. Participants received feedback on their web assignments by e-mail [St]. (<i>monitoring; tailored communication</i>) Participants received a reminder e-mail to address topics related to each web assignment and a refresher on the previous week's web content [St]. (<i>invitations/reminders</i>) After a 3-min interview, participants received an information sheet with the project's website address and a space for them to record their user-ID and password [St]. Participants were instructed to visit and register at the project website the next day between noon and 8 p.m. [St]. (<i>invitations/reminders</i>) Participants received their own and the average BAC of their entire hall for the previous night (normative feedback [Me], based on Social Norms Theory [T]); other alcohol information about interpreting a BAC reading an alcohol poisoning, interactive assessment activities, including motivation enhancement pages for reluctant and ambivalent high-risk drinkers; and links to counseling services [St]. (<i>tailored communication; interactive content</i>) Participants enrolled into the project's weekly lottery [St]. (<i>incentives</i>) Nighttime staff members reminded each resident to participate the following day and provided them with the hours the website would be available to them [St]; lollipops with reminder tags taped to the stick identifying the website were distributed [St]; flyers were posted throughout each hall [St]; hand stamps were used to identify the website URL [St]. (<i>invitations/reminders</i>)	Completion assignments: >90%
Suminski & Petosa (2006); nine web assignments; one per week		Frequency: 7,087 nighttime interviews \rightarrow 61% visited website next day; 55% from male population, 71% female population Per activity: 11 students conduct an online self-assessment of their readiness to change their drinking behaviors no one contacted the clinician involved
Thombs et al. (2007); during one academic year in two resident halls from 10 p.m. to 3 a.m., Wednesday through Saturday		

(continued)

Table 2. (continued)

Study/setting	Methods, strategies, and foundation	Exposure measures
White et al. (2004); Williamson et al. (2005, 2006); 2 years; results, however, relate to the first 6 months	<p>Passive condition: interactive graph to track weight loss; healthy menu ideas; ability to e-mail case manager. Interactive condition also: weekly treatment sessions including a quiz; interactive graph to track exercise; internet counseling; interactive food monitoring worksheets with instant feedback; treatment strategies; structured programs to increase physical activity [St]. Participants were encouraged to send e-mail weekly regarding their progress in the intervention. This allowed counselors to provide feedback on intervention components [St]. (<i>interactive content; monitoring; professional support; tailored communication</i>)</p> <p>Websites were designed to present culturally specific information [Me], including links to other websites containing culturally relevant diet and physical activity information, recipes for foods commonly eaten by African Americans, links to websites designed for African Americans and the inclusion of chat rooms for participants only [St]. (<i>targeted communication</i>)</p> <p>Modules in correspondence with sessions [St]. (<i>conditional progress</i>)</p> <p>School liaisons [St] for implementing the intervention on campus, encouraging completion of counseling sessions. (<i>social context</i>)</p> <p>A sky mall was chosen as the virtual setting because malls frequently serve as meeting places for teens [St]. (<i>targeted communication</i>)</p> <p>Peer-to-peer interaction; real-time discussion between four adolescent smokers and counselor [St] who conducted motivational interviewing [Me]. (<i>peer support; professional support</i>)</p>	<p>Frequency: visits: interactive condition > passive condition: ($t(55) = 5.07, p < .001$) hits: interactive: $M = 624.9$ (444.1); passive: $M = 186.4$ ($SD = 137.6$)</p> <p>Completed quizzes: $M = 9.75$ ($SD = 8.17$); score > 60%: $M = 7.96$ ($SD = 7.10$); decrease over time, $t(27) = 5.37, p < .001$</p>
Woodruff et al. (2008, 2007); seven sessions (± 45 min), over a 7-week period, in which attendance was recorded	<p>Frequency (attendance): $M = 3$ sessions 19% no sessions 9% all sessions</p>	

Note: Labeling in italics is used for the sake of clarity, NA = not available; Me = method; St = strategy; T = theoretical foundation, BASICS = Brief Alcohol Screening and Intervention for College Students.

these theories could also be used to facilitate exposure. For example, offering a game (a peripheral cue in terms of the elaboration likelihood model that aims to explain attitude change) in which participants had to crush virtual cigarettes led to an increase in exposure to a 12-week psychosocial minimal-support treatment program (Girard, Turcotte, Bouchard, & Girard, 2009). Furthermore, some theoretical assumptions were described without explicitly mentioning an underlying theory. For example, one study (An et al., 2006) described that the benefits of a simple linear design may be particularly pronounced when a participant's investment in a website is low without referring to a theory or empirical data. Empirical data as a basis for methods and strategies (e.g., needs assessment) was barely described. If so, participants' preferences (e.g., communication through e-mail or discussion board) were investigated during the development process (Lou, Zhao, Gao, & Shah, 2006).

RQ3: Which Measures Are Used to Assess Exposure and How Are These Exposure Measures Linked to Strategies to Facilitate Exposure? (Table 1 and 2)

The number of (unique) visitors was mostly reported, but several other measures were also used to assess exposure, for example, frequency of visiting, duration of visit, and number of pages visited, as shown in the third column of Table 2. Furthermore, whether certain tasks were conducted was also used as an exposure measure. For each intervention, however, only a few of these measures were reported, resulting in a heterogeneous description of exposure to intervention websites.

Twelve interventions used objectively tracked exposure measures (e.g., by means of server data), one intervention relied on self-reported exposure measures, and two interventions combined both methods. (Escoffery et al., 2004, reported 82.4% agreement between objectively tracked and self-reported exposure measures.) The remaining two interventions were session based, and only participants' attendance to these sessions was recorded.

Nine of those 17 interventions reported exposure measures per component, which made it possible to link them to strategies used. Furthermore, two of those nine interventions made a distinction between interactive and non-interactive content. Eight interventions reported exposure measures for the intervention's website as a whole.

RQ4: What Are the Potential Effects of Strategies to Facilitate Exposure and How Are These Related to Their Theoretical or Empirical Foundation? (Tables 1 and 2)

Results of those nine interventions that reported exposure measures per component showed that discussion boards were

only moderately used for peer support. For example, 452 participants registered on a discussion board regarding sexual and reproductive health, but only a few comments were posted (Lou et al., 2006). Although professional support (e.g., ask-the-expert) was often provided, it was only limitedly used. From those interventions that made a distinction between interactive and noninteractive content, it appeared that providing content in a more interactive way resulted in higher exposure. In an Internet-based lifestyle behavior modification intervention for weight management, participants in the interactive condition visited the website more often than participants in the passive condition, $t(55) = 5.07$, $p < .001$ (White et al., 2004; Williamson et al., 2005; Williamson et al., 2006). Descriptive statistics of a website for adolescent smoking cessation indicated more page views for interactive pages compared to informational pages ($Mdn = 65$ vs. $Mdn = 6$; Patten et al., 2006; Patten et al., 2007).

Other interventions used a combination of several methods and strategies, which complicates dismantling the effectiveness to single methods and strategies by looking at exposure measures with regard to the intervention's website as a whole. The combination of tailored communication, the use of reminders to visit or revisit or invitations to participate, and the use of incentives, however, resulted in high exposure to Internet-delivered interventions. In an online college-life magazine targeting college smokers, for example, on average 95% of participants returned weekly to the website and completed a tracker and interactive quiz. Notably, there was no decline over 20 weeks (An et al., 2006). In another intervention, designed to deter alcohol use in residence halls, 61% visited the website the day after they consumed alcohol (Thombs et al., 2007).

It is premature to draw definite conclusions regarding effectiveness of strategies to facilitate exposure, because their use was inconsistently linked to exposure measures. Moreover, it was difficult to relate effectiveness to theories or empirical data that served as the ground for the use of methods and strategies, because theories or empirical data were hardly linked to exposure measures.

Discussion

This systematic review resulted in an overview of methods and strategies that have been used to facilitate exposure to Internet-delivered interventions aimed at adolescents or young adults. It appeared that frequently used strategies (e.g., ask-the-expert, discussion boards) were moderately or even seldom used by adolescents or young adults, even though they were suggested by experts (Crutzen et al., 2008b) and the target group (Crutzen et al., 2008a) as factors that might be associated with exposure to Internet-delivered interventions in previous studies. Interventions that combined several strategies were most effective with regard to facilitating exposure. As most interventions used a combination of several strategies, it is rendered more difficult to study the

effectiveness of single strategies. It is recommended to conduct experimental research in more controlled settings to increase evidence-based insight into their effectiveness regarding exposure, before applying these strategies in practice. Furthermore, a meta-analytical approach can be used to detect robust effects regarding the effectiveness of certain strategies (e.g., the use of reminders; Göritz & Crutzen, 2010).

In the studies included in the review, there was only a limited description of the strategies or efforts taken to facilitate exposure to the intervention. This knowledge is crucial, however, to get more insight into ways to improve exposure to Internet-delivered interventions and consequently, to increase behavioral change. In addition to a description of the educational content of an Internet-delivered intervention, future studies should also describe which strategies they have used specifically to attract attention to the intervention and to make using the intervention and revisiting it (when applicable) attractive (Danaher & Seeley, 2009), to gain more insight into potential effective strategies to improve exposure.

Although most studies did make explicit what theory was used to inform the intervention, these theories were primarily behavior determinants or behavior change theories. No exposure-specific theories were mentioned in the reviewed studies. Therefore, more attention should be paid to the development and application of theories regarding exposure, from which methods and strategies can be derived. This recommendation has also been acknowledged within the field of mental health (Christensen, Griffiths, & Farrer, 2009).

Moreover, it remains unclear how we decide whether methods and strategies regarding Behavior A are also applicable to Behavior B. A recent review has focused on similarities between behavior-specific determinants of four health behaviors: smoking, (binge) drinking, safe sex, and healthy nutrition (Peters et al., 2009). Although several determinants were found to be relevant for all four behaviors, 51 of a total of 86 determinants could not be classified meaningfully to a higher level or have only been studied for one behavior. Other research has shown that addictive behaviors (smoking, alcohol consumption; De Vries et al., 2008) and energy balance-related behaviors (physical activity, fruit consumption; Kremers, De Bruijn, Schaalma, & Brug, 2004) are clustered. This stresses the possible difficulty to generalize findings regarding strategies to facilitate exposure to Internet-delivered interventions from one health behavior to others. Hence, effective strategies can be derived from Internet-delivered interventions focusing on different behaviors, but behavior-specific evidence-based insight needs to be gained.

It is premature, because of the heterogeneity of exposure measures and inconsistent linkage of these exposure measures to strategies used in Internet-delivered interventions, to make a valid comparison between strategies used in these interventions and theories or empirical data on which they are based. More uniformity in reporting exposure measures would make it possible to compare or pool the results of various studies.

This is in line with recommendations for exposure measures regarding “offline” interventions, for example national campaigns (Southwell, Barmada, Hornik, & Maklan, 2002) and community-based interventions (Morris, 2009).

Implications for Practice

This overview can be useful for practice to choose potential strategies to be used in Internet-delivered interventions to improve exposure. It needs to be stressed that methods and strategies that have been used to facilitate exposure do not need to be applied separately. For example, providing content in an interactive way can be combined with monitoring health behavior and behavior change. Furthermore, during the development of an Internet-delivered intervention, strategies can also be derived from interventions focusing on different behaviors. For example, if one develops an Internet-delivered intervention that aims to promote safe sex behaviors, one may look at Internet-delivered interventions related to smoking cessation to get ideas about certain strategies. However, this does not guarantee the effectiveness of these strategies in the context of promoting safe sex behaviors.

With regard to exposure measures, it is recommended to track and report multiple exposure measures (e.g., frequency of visiting, duration of visit, and number of pages visited; Crutzen, De Nooijer, Candel, & De Vries, 2008). Each exposure measure relates to a different aspect of exposure (Danaher, Boles, Akers, Gordon, & Severson, 2006). One can visit an intervention very frequently, for example, but only for a short period of time. Duration of visits, on the other hand, does not necessarily give a clear picture of participants’ online activity, because one does not know what parts of the intervention website are actually used. Therefore, the number of visited webpages would be more appropriate to assess online activity (Crutzen, 2009). Most exposure measures can be tracked objectively, which is preferable above self-reported exposure measures that are dependent on participants’ memory, interpretation, and social desirability bias. If exposure measures were linked to intervention outcome measures at the individual level, it would also be possible to study potentially effects of exposure on these outcome measures.

There are no known technical barriers to track exposure measures of Internet-delivered interventions. It is important, however, to realize this from the start of an intervention development process and to involve technical staff during this initial phase (Crutzen et al., 2009). We recommend tracking as many exposure measures as possible because there is no gold standard (Crutzen, 2009). Furthermore, having exposure measures available is also useful during process evaluation of Internet-delivered interventions, as has been shown in other studies (Barak & Fisher, 2003; Lou et al., 2006; Patten et al., 2007; Roberto, Zimmerman, Carlyle, & Abner, 2007). These exposure measures provide detailed insight into where participants either leave the intervention website or have come to a standstill. This information can be used to adapt

interventions to users' needs and therewith increase exposure rates and probability of behavior change.

Limitations

The process of dissemination was described only to a limited extent in the included studies, and most interventions were applied in a research setting and participants were recruited to participate in a study. Although the focus of this review was not on dissemination of Internet-delivered interventions, successful dissemination is required before participants can be exposed to the intervention. Dissemination involves the distribution of the intervention among the target population, including bringing the intervention to the attention of the target population. Successful dissemination depends on the target population, the source, and the intervention itself (Rogers, 2003). It needs to be stressed that server registrations can be used during the process of dissemination to determine where your visitors came from (e.g., banner ads, links from other websites).

Incentives and advertisements that were used to increase attention mostly focused on convincing people to participate in a study instead of an intervention and target sample sizes were based on power calculations instead of the public health impact if the Internet-delivered intervention would be implemented in real-life. In general, use of incentives is a strategy that is probably inapplicable once an Internet-delivered intervention is implemented in real-life, because this would increase costs enormously. Nevertheless, other incentives, for example, the receipt of valued information or social reinforcers, might be more useful in practice. Furthermore, embedding an Internet-delivered intervention in a social context could be defined as a feasible and appropriate way to disseminate it, for example, by linking the intervention to school activities (Crutzen, De Nooijer, & De Vries, 2008). The feasibility, appropriateness, and effectiveness of such a social context could be explained by the infrastructure being available and intermediaries (e.g., teachers) being accustomed to such settings (e.g., providing education during class hours) (Reinaerts, De Nooijer, & De Vries, 2007).

Sixty-seven percent of corresponding authors responded to our request to complete the extraction forms. A possible explanation why other authors did not respond could be that they did not want to provide the information we requested because it was unavailable or would create negative publicity regarding their intervention. Although this nonresponse and a possible publication bias might have skewed the results, we think that this is not the case because the included studies were aimed at assessing the efficacy of Internet-delivered interventions and not to test strategies that facilitate exposure. Furthermore, corresponding authors were very willing to share information regarding their intervention. This resulted, however, in very little new information. Therefore, it remains unclear whether information with regard to exposure methods, strategies, and their effectiveness was unavailable or not meant to be shared.

Finally, included studies were limited to original articles published in peer-reviewed English-language journals, and

strict inclusion and exclusion criteria were followed. In our zeal to be parsimonious and systematic in our review, we may have discarded other potentially valuable studies (e.g., Buller et al., 2008).

Conclusion

The results of this systematic review revealed potential strategies that can be used in practice to facilitate exposure to Internet-delivered interventions (e.g., the combination of tailored communication and the use of reminders and incentives) and stress the importance of tracking and reporting exposure measures. Moreover, the formation of further research questions regarding effectiveness of specific strategies is deemed necessary to fully utilize the potential of Internet-delivered interventions and increase their public health impact.

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